Photoidentification catalog of Cuvier's beaked whale *(Ziphius cavirostris)* in the Ligurian Sea

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INTRODUCTION

The 21 species of beaked whales, or ziphiids, are among the least known vertebrates on earth, due in part to their cryptic behavior and often remote pelagic distribution. Since the 1980's, a surge in the knowledge of beaked whale natural history and taxonomy has resulted from genetic analysis of tissues from stranded animals and field research conducted by scientists in various offshore ocean basins. One species, Cuvier's beaked whale, *Ziphius cavirostris*, has been the subject of intense research over the last several years, due to its tendency to mass strand in the vicinity of naval mid-frequency sonar activities.

Since 1998, summer surveys for cetaceans have been conducted opportunistically by a commercial whale watching operation, BluWest, in the northern Ligurian Sea between Genoa and Imperia, Italy, resulting in sightings of numerous Cuvier's beaked whales (Ballardini et al. 2006, Biassoni et al. 2003). As a result of these opportunistic sightings, the Woods Hole Oceanographic Institution (WHOI) began directed studies, in cooperation with BluWest, of Cuvier's beaked whale in the same geographic area to gather baseline natural history data using a non-invasive digital acoustic tag (Dtag). These surveys were conducted during the summer and fall months from 2001-2006. Additionally, directed surveys for Cuvier's beaked whales were carried out by BluWest for one day each month during 2004-2006.

Whenever beaked whales were encountered, efforts were made to photograph each individual using digital and film cameras. Photo-identification is a fundamental tool in identifying individual animals by natural markings, such as scarring and pigmentation patterns, and can be used to estimate residence patterns, density and abundance of animals in a given geographic area.

Cuvier's beaked whales show tremendous variation in coloration and scarring patterns depending on their age and sex. In general, adult males tend to be very white in coloration and are heavily scarred over their entire body. Two teeth are also visible at the tip of their lower jaw. Adult females tend to show greater variety in their pigmentation, ranging from dark brown with pale melons to very pale cream colored animals, with little or no scarring evident on their bodies. Females also lack visible teeth at the tip of their jaws. Immature whales typically are entirely dark brown, lack pale melons, have little to no scars visible, and lack visible teeth (McSweeney et al. 2007). Scarring and pigmentation can be used to classify individuals; in this study, four classes are

recognized: **very distinctive** (heavily scarred and/or bold pigmentation), **distinctive** (many distinct scars and/or bold pigmentation), **slightly distinctive** (few scars and lack of bold pigmentation), and **not distinctive** (no scars and solid brown animal; McSweeney et al. 2007, Claridge 2004).

From 1998-2007, a total of over 2,300 photographs were obtained of Cuvier's beaked whales in the northern Ligurian Sea, of which 650 showed enough of the dorsal and fin and scarring patterns to be included in the catalog. Each photograph in the catalog was then classified as excellent, good, fair, and poor depending on clarity (sharpness) of the image, the position of the animal relative to the photographer, and if the photo was taken in good light.

From these photographs we were able to recognize 127 individual whales, of which we identified 10 adult males, 3 adult females, 3 calves, and 27 immature whales, based on the criteria listed above. For many animals, we were unable to positively determine the sex of an individual when the presence of teeth could not be confirmed. For that reason we have classified 26 possible males (based on heavy scarring and white coloration) and 28 possible females (lack of scarring, often with a pale melon). Out of the 127 individual whales, 34 were resighted during the 9 year study period (600 hours of effort). This rate of resighting individual whales suggests a fairly small population size (McSweeney et al. 2007, Baird et al. 2006) and indicates that scarring and pigmentation patterns are a durable means of identification

The most resighted animal was an adult male who was seen 6 times from 2003 to 2005. Seven years was the longest time between resights; three animals (1 female and 2 possible males) were seen first in 1998 and last in 2005.

While this catalog is incomplete (due to a lack of standardized methods for collecting the photographs, positions, and dates of all sightings), it does provide good baseline information for future work on Cuvier's beaked whales in the northern Ligurian Sea. Further analysis of this data set and dedicated efforts to obtain more photographs of Cuvier's beaked whales in this region will improve our knowledge about this population. Efforts should also be made to obtain biopsies along with the photographs, to verify our association of genders and ages with coloration.

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